



KCNT1 gene

potassium sodium-activated channel subfamily T member 1

Normal Function

The *KCNT1* gene belongs to a large family of genes that provide instructions for making potassium channels. These channels, which transport positively charged atoms (ions) of potassium into and out of cells, play a key role in a cell's ability to generate and transmit electrical signals.

The specific function of a potassium channel depends on its protein components and its location in the body. Channels made with the KCNT1 protein are active in nerve cells (neurons) in the brain, where they transport potassium ions out of cells. This flow of ions is involved in generating currents to activate (excite) neurons and send signals in the brain.

Potassium channels are made up of several protein components (subunits). Each channel contains four alpha subunits that form the hole (pore) through which potassium ions move. Four alpha subunits from the *KCNT1* gene can form a channel. The KCNT1 alpha subunits can also interact with alpha subunits produced from the *KCNT2* gene to form a functional potassium channel.

Researchers have determined that a molecule called PKC can turn on channels made with the KCNT1 protein. While the channels can generate electrical currents without PKC, when PKC turns the channel on, the currents are stronger.

Health Conditions Related to Genetic Changes

autosomal dominant nocturnal frontal lobe epilepsy

malignant migrating partial seizures of infancy

At least six *KCNT1* gene mutations have been found in individuals with malignant migrating partial seizures of infancy (MMPSI). This condition is characterized by recurrent seizures beginning before the age of 6 months as well as profound developmental delay. In MMPSI, seizure activity in the brain can spread (migrate) from one region to another during an episode.

The *KCNT1* gene mutations involved in MMPSI change single protein building blocks (amino acids) in the KCNT1 protein. The electrical currents generated by potassium channels made with the altered KCNT1 protein are abnormally increased, as though the channels were turned on by PKC. The increased electrical currents allow unregulated excitation of neurons in the brain. When neurons are abnormally

excited, seizures develop. Repeated seizures contribute to the developmental delay that is characteristic of this condition.

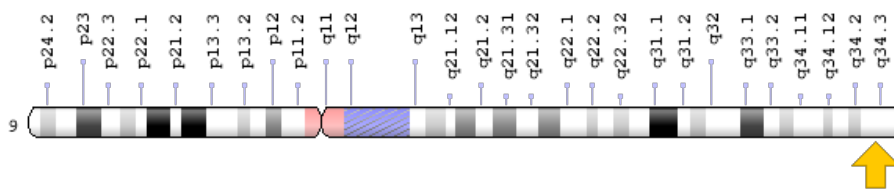
other disorders

Mutations in the *KCNT1* gene have been found in several people with autosomal dominant nocturnal frontal lobe epilepsy (ADNFLE), which causes seizures that usually occur at night (nocturnally) while an affected person is sleeping. In addition to seizures, most affected individuals with *KCNT1* gene mutations have psychiatric problems, such as aggression, episodes of unresponsiveness (catatonia), or a distorted view of reality (psychosis), and about half have intellectual disability. The *KCNT1* gene mutations involved in this condition change single amino acids in the KCNT1 protein; however, it is unclear what effects these changes have on the function of potassium channels or how they lead to the features of ADNFLE.

Chromosomal Location

Cytogenetic Location: 9q34.3, which is the long (q) arm of chromosome 9 at position 34.3

Molecular Location: base pairs 135,700,807 to 135,793,147 on chromosome 9 (Homo sapiens Annotation Release 108, GRCh38.p7) (NCBI)



Credit: Genome Decoration Page/NCBI

Other Names for This Gene

- EIEE14
- ENFL5
- KCa4.1
- KCNT1_HUMAN
- KIAA1422
- potassium channel subfamily T member 1
- potassium channel, sodium activated subfamily T, member 1
- potassium channel, subfamily T, member 1

- SLACK
- Slo2.2

Additional Information & Resources

Educational Resources

- Biochemistry (fifth edition, 2002): Action Potentials Are Mediated by Transient Changes in Na⁺ and K⁺ Permeability
<https://www.ncbi.nlm.nih.gov/books/NBK22509/#A1816>

Scientific Articles on PubMed

- PubMed
<https://www.ncbi.nlm.nih.gov/pubmed?term=%28KCNT1%5BTIAB%5D%29+OR+%28SLACK%5BTIAB%5D%29+AND+%28%28Genes%5BMH%5D%29+OR+%28Genetic+Phenomena%5BMH%5D%29%29+AND+english%5Bla%5D+AND+human%5Bmh%5D+AND+%22last+3600+days%22%5Bdp%5D>

OMIM

- POTASSIUM CHANNEL, SUBFAMILY T, MEMBER 1
<http://omim.org/entry/608167>

Research Resources

- Atlas of Genetics and Cytogenetics in Oncology and Haematology
http://atlasgeneticsoncology.org/Genes/GC_KCNT1.html
- ClinVar
<https://www.ncbi.nlm.nih.gov/clinvar?term=KCNT1%5Bgene%5D>
- HGNC Gene Family: Potassium sodium-activated channel subfamily T
<http://www.genenames.org/cgi-bin/genefamilies/set/856>
- HGNC Gene Symbol Report
http://www.genenames.org/cgi-bin/gene_symbol_report?q=data/hgnc_data.php&hgnc_id=18865
- NCBI Gene
<https://www.ncbi.nlm.nih.gov/gene/57582>
- UniProt
<http://www.uniprot.org/uniprot/Q5JUK3>

Sources for This Summary

- Barcia G, Fleming MR, Deligniere A, Gazula VR, Brown MR, Langouet M, Chen H, Kronengold J, Abhyankar A, Cilio R, Nitschke P, Kaminska A, Boddaert N, Casanova JL, Desguerre I, Munnich A, Dulac O, Kaczmarek LK, Colleaux L, Nabbout R. De novo gain-of-function KCNT1 channel mutations cause malignant migrating partial seizures of infancy. *Nat Genet.* 2012 Nov;44(11):1255-9. doi: 10.1038/ng.2441. Epub 2012 Oct 21.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/23086397>
Free article on PubMed Central: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3687547/>
- Bhattacharjee A, Kaczmarek LK. For K⁺ channels, Na⁺ is the new Ca²⁺. *Trends Neurosci.* 2005 Aug;28(8):422-8. Review.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/15979166>
- Heron SE, Smith KR, Bahlo M, Nobili L, Kahana E, Licchetta L, Oliver KL, Mazarib A, Afawi Z, Korczyn A, Plazzi G, Petrou S, Berkovic SF, Scheffer IE, Dibbens LM. Missense mutations in the sodium-gated potassium channel gene KCNT1 cause severe autosomal dominant nocturnal frontal lobe epilepsy. *Nat Genet.* 2012 Nov;44(11):1188-90. doi: 10.1038/ng.2440. Epub 2012 Oct 21.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/23086396>
- Ishii A, Shioda M, Okumura A, Kidokoro H, Sakauchi M, Shimada S, Shimizu T, Osawa M, Hirose S, Yamamoto T. A recurrent KCNT1 mutation in two sporadic cases with malignant migrating partial seizures in infancy. *Gene.* 2013 Dec 1;531(2):467-71. doi: 10.1016/j.gene.2013.08.096. Epub 2013 Sep 10.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/24029078>
- OMIM: POTASSIUM CHANNEL, SUBFAMILY T, MEMBER 1
<http://omim.org/entry/608167>
- Santi CM, Ferreira G, Yang B, Gazula VR, Butler A, Wei A, Kaczmarek LK, Salkoff L. Opposite regulation of Slick and Slack K⁺ channels by neuromodulators. *J Neurosci.* 2006 May 10;26(19):5059-68.
Citation on PubMed: <https://www.ncbi.nlm.nih.gov/pubmed/16687497>

Reprinted from Genetics Home Reference:
<https://ghr.nlm.nih.gov/gene/KCNT1>

Reviewed: March 2014
Published: March 21, 2017

Lister Hill National Center for Biomedical Communications
U.S. National Library of Medicine
National Institutes of Health
Department of Health & Human Services